

U.S. Patent Application Serial No. 10/511,442
Amendment filed December 28, 2006
Reply to OA dated September 22, 2006

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently Amended): A process for producing a synthetic resin foam comprising the step of reacting at least one polyol with at least one polyisocyanate compound in the presence of an organic blowing agent and a catalyst,

the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane (HFC-365mfc) and at least one halogen-containing compound,

wherein the organic blowing agent and the polyol mixture forms a premix which is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C,

the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ($\text{CF}_2=\text{CFOCF}_3$), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ($\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$), perfluoropropyl epoxide ($\text{CF}_3\text{CF}(\text{O})\text{CF}_2$), perfluoro-1-butene ($\text{CF}_2=\text{CFCF}_2\text{CF}_3$), perfluorohexenes (C_6F_{12}), perfluorononenes (C_9F_{18}), perfluorohexane (C_6F_{14}), perfluorocyclobutane (*c*- C_4F_8), iodotrifluoromethyl (CF_3I),

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1,1,1,2,3,3-hexafluoropropane ($\text{CF}_3\text{CFHCF}_2\text{H}$), 1,1,1,3,3,3-hexafluoropropane ($\text{CF}_3\text{CH}_2\text{CF}_3$), 1,1,1,2,3,3,3-heptafluoropropane ($\text{CF}_3\text{CFHCF}_3$), pentafluoroethane ($\text{CF}_3\text{CF}_2\text{H}$), tetrafluoroethanes (CHF_2CHF_2 , CF_3CFH_2), trifluoromethane (CF_3H), 1,1,2,2,3,3,4,4-octafluorobutane ($\text{CF}_2\text{HCF}_2\text{CF}_2\text{CF}_2\text{H}$), 1,1,1,2,2,3,4,5,5,5-decafluoropentane ($\text{CF}_3\text{CF}_2\text{CFHCFHCF}_3$), 2-trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane ($\text{C}_6\text{F}_{12}\text{H}_2$), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ($\text{F}(\text{CF}_2)_4\text{CH}=\text{CH}_2$), 2,3,3,4,4,5,5-heptafluoro-1-pentene ($\text{CH}_2\text{CFCF}_2\text{CF}_2\text{CF}_2\text{H}$), trifluoroethylene (CF_2CFH), 1,1,2,2-tetrafluoroethyl difluoromethyl ether ($\text{CF}_2\text{HCF}_2\text{OCHF}_2$), 1,1,2,2-tetrafluoroethyl methyl ether ($\text{CF}_2\text{HCF}_2\text{OCH}_3$), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether ($\text{CF}_3\text{CH}_2\text{OCF}_2\text{CF}_2\text{H}$), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether ($\text{CF}_3\text{CFHCF}_2\text{OCH}_3$), nonafluorobutyl methyl ether ($\text{C}_4\text{F}_9\text{OCH}_3$), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ($(\text{CF}_3)_2\text{CFOCH}_3$), perfluoropropyl methyl ether ($\text{CF}_3\text{CF}_2\text{CF}_2\text{OCH}_3$), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether ($\text{CF}_3\text{CF}_2\text{CH}_2\text{OCHF}_2$), 1,2,3,3,4,4-hexafluorocyclobutane ($c\text{-C}_4\text{F}_6\text{H}_2$), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane ($\text{CF}_2\text{ClCF}_2\text{CF}_2\text{CF}_2\text{H}$, boiling point: 50°C), 1,2-dichlorohexafluorocyclobutane ($\text{-CFCICFCICF}_2\text{CF}_2\text{-}$, boiling point: 60°C), and 1,1,1,3,3,3-hexafluoropropan-2-ol ($\text{CF}_3\text{CH}(\text{OH})\text{CF}_3$, boiling point: 59°C);

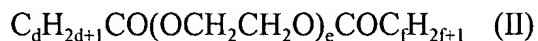
wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and

wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):

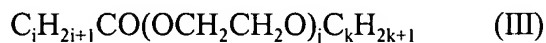


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wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



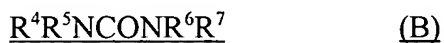
wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4, and the amide compound is at least one member selected from the group consisting of those of the following Formulae (A) and (B):



wherein R¹ is a hydrogen atom, a lower alkyl group or a phenyl group; and R² and R³ are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with the proviso that R¹ and R² may form a heterocyclic ring in conjunction with the carbon atom of the carbonyl group to which R¹ is bound and the nitrogen atom to which R² is bound; and



wherein R⁴, R⁵, R⁶ and R⁷ are the same or different, and represent a hydrogen atom or a lower alkyl group, with the proviso that R⁴ and R⁶ may form a heterocyclic ring in conjunction with the nitrogen atom to which R⁶ is bound, the nitrogen atom to which R⁴ is bound and the carbon atom of the carbonyl group.

Claims 2-4: (Canceled).

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Claim 5 (Previously Presented): The process according to Claim 1, wherein the halogen-containing compound has a boiling point lower than the boiling point of HFC-365mfc (40°C).

Claim 6 (Currently Amended): The process according to Claim 1, wherein the halogen-containing compound is nonflammable and has a boiling point of about 10 to about 60°C and a thermal conductivity when it is in the gaseous state of about 8 to about 20 mW/mK at about 1 atmospheric pressure, and the halogen-containing compound is at least one member selected from the group consisting of perfluorohexane (C₆F₁₄), 1,1,2,2-tetrafluoroethyl difluoromethyl ether (CF₂HCF₂OCHF₂), 1,1,2,2-tetrafluoroethyl methyl ether (CF₂HCF₂OCH₃) and 2,2,2-trifluoroethyl-1,1,2,2-tetrafluoroethyl ether (CF₃CH₂OCF₂CF₂H).

Claims 7-9: (Canceled).

Claim 10 (Previously Presented): The process according to Claim 1, wherein the halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea: CF₃CFHCF₃).

Claim 11 (Previously Presented): The process according to Claim 1, wherein the proportion of halogen-containing compound is about 1 to about 49 mol per 100 mol of HFC-365mfc and halogen-containing compound in total.

Claim 12 (Previously Presented): The process according to Claim 1, wherein the catalyst is a tertiary amine, an organometallic compound, or a mixture thereof.

Claim 13 (Currently Amended): An organic blowing agent for producing a synthetic resin foam, the organic blowing agent comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound, ~~the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound;~~

wherein the organic blowing agent and a polyol mixture forms a premix which is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C,

the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ($\text{CF}_2=\text{CFOCF}_3$), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ($\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$), perfluoropropyl epoxide ($\text{CF}_3\text{CF}(\text{O})\text{CF}_2$), perfluoro-1-butene ($\text{CF}_2=\text{CFCH}_2\text{CF}_3$), perfluorohexenes (C_6F_{12}), perfluorononenes (C_9F_{18}), perfluorohexane (C_6F_{14}), perfluorocyclobutane ($c\text{-C}_4\text{F}_8$), iodotrifluoromethyl (CF_3I), 1,1,1,2,3,3-hexafluoropropane ($\text{CF}_3\text{CFHCF}_2\text{H}$), 1,1,1,3,3,3-hexafluoropropane ($\text{CF}_3\text{CH}_2\text{CF}_3$), 1,1,1,2,3,3,3-heptafluoropropane ($\text{CF}_3\text{CFHCF}_3$), pentafluoroethane ($\text{CF}_3\text{CF}_2\text{H}$), tetrafluoroethanes

(CHF₂CHF₂, CF₃CFH₂), trifluoromethane (CF₃H), 1,1,2,2,3,3,4,4-octafluorobutane (CF₂HCF₂CF₂CF₂H), 1,1,1,2,2,3,4,5,5,5-decafluoropentane (CF₃CF₂CFHCFHCF₃), 2-trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane (C₆F₁₂H₂), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene (F(CF₂)₄CH=CH₂), 2,3,3,4,4,5,5-heptafluoro-1-pentene (CH₂CFCF₂CF₂CF₂H), trifluoroethylene (CF₂CFH), 1,1,2,2-tetrafluoroethyl difluoromethyl ether (CF₂HCF₂OCHF₂), 1,1,2,2-tetrafluoroethyl methyl ether (CF₂HCF₂OCH₃), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether (CF₃CH₂OCF₂CF₂H), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether (CF₃CFHCF₂OCH₃), nonafluorobutyl methyl ether (C₄F₉OCH₃), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ((CF₃)₂CFOCH₃), perfluoropropyl methyl ether (CF₃CF₂CF₂OCH₃), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether (CF₃CF₂CH₂OCHF₂), 1,2,3,3,4,4-hexafluorocyclobutane (*c*-C₄F₆H₂), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane (CF₂ClCF₂CF₂CF₂H, boiling point: 50°C), 1,2-dichlorohexafluorocyclobutane (-CFCICFCICF₂CF₂-, boiling point: 60°C), and 1,1,1,3,3,3-hexafluoropropan-2-ol (CF₃CH(OH)CF₃, boiling point: 59°C);

wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):

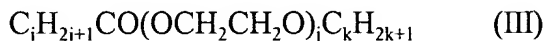


wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



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wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4, and the amide compound is at least one member selected from the group consisting of those of the following Formulae (A) and (B):



wherein R^1 is a hydrogen atom, a lower alkyl group or a phenyl group; and R^2 and R^3 are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with the proviso that R^1 and R^2 may form a heterocyclic ring in conjunction with the carbon atom of the carbonyl group to which R^1 is bound and the nitrogen atom to which R^2 is bound; and



wherein R^4 , R^5 , R^6 and R^7 are the same or different, and represent a hydrogen atom or a lower alkyl group, with the proviso that R^4 and R^6 may form a heterocyclic ring in conjunction with the nitrogen atom to which R^6 is bound, the nitrogen atom to which R^4 is bound and the carbon atom of the carbonyl group.

Claims 14-15: (Canceled).

Claim 16 (Previously Presented): The blowing agent according to Claim 13, wherein the halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea: $\text{CF}_3\text{CFHCF}_3$).

Claim 17 (Currently Amended): A premix for producing a synthetic resin foam, the premix comprising an organic blowing agent ~~1,1,1,3,3-pentafluorobutane, at least one halogen-~~
~~containing compound~~ and at least one polyol,

the blowing agent being a mixture comprising 1,1,1,3,3-pentafluorobutane and at least one halogen-containing compound,

wherein the premix is substantially nonflammable;

wherein the at least one halogen-containing compound is nonflammable and has a relatively low thermal conductivity and a boiling point of about -90 to about 60°C ,

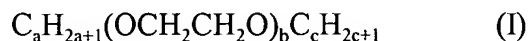
the thermal conductivity of the halogen-containing compounds in the gaseous state is about 8 to about 30 mW/mK at about 1 atmospheric pressure, and

the halogen-containing compound is at least one member selected from the group consisting of 1,2,2-trifluoroethylene trifluoromethyl ether ($\text{CF}_2=\text{CFOCF}_3$), 1,2,2-trifluoroethylene 1,1,2,2,3,3,3-heptafluoropropyl ether ($\text{CF}_2=\text{CFOCF}_2\text{CF}_2\text{CF}_3$), perfluoropropyl epoxide ($\text{CF}_3\text{CF}(\text{O})\text{CF}_2$), perfluoro-1-butene ($\text{CF}_2=\text{CFCH}_2\text{CF}_3$), perfluorohexenes (C_6F_{12}), perfluorononenes (C_9F_{18}), perfluorohexane (C_6F_{14}), perfluorocyclobutane (*c*- C_4F_8), iodotrifluoromethyl (CF_3I), 1,1,1,2,3,3,3-hexafluoropropane ($\text{CF}_3\text{CFHCF}_2\text{H}$), 1,1,1,3,3,3-hexafluoropropane ($\text{CF}_3\text{CH}_2\text{CF}_3$), 1,1,1,2,3,3,3-heptafluoropropane ($\text{CF}_3\text{CFHCF}_3$), pentafluoroethane ($\text{CF}_3\text{CF}_2\text{H}$), tetrafluoroethanes (CHF_2CHF_2 , CF_3CFH_2), trifluoromethane (CF_3H), 1,1,2,2,3,3,4,4-octafluorobutane ($\text{CF}_2\text{HCF}_2\text{CF}_2\text{CF}_2\text{H}$), 1,1,1,2,2,3,4,5,5,5-decafluoropentane ($\text{CF}_3\text{CF}_2\text{CFHCFHCF}_3$), 2-

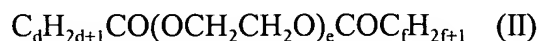
trifluoromethyl-1,1,1,2,3,4,5,5,5-nonafluoropentane ($C_6F_{12}H_2$), 3,3,4,4,5,5,6,6,6-nonafluoro-1-hexene ($F(CF_2)_4CH=CH_2$), 2,3,3,4,4,5,5-heptafluoro-1-pentene ($CH_2CFCF_2CF_2CF_2H$), trifluoroethylene (CF_2CFH), 1,1,2,2-tetrafluoroethyl difluoromethyl ether ($CF_2HCF_2OCHF_2$), 1,1,2,2-tetrafluoroethyl methyl ether ($CF_2HCF_2OCH_3$), 2,2,2-trifluoroethyl 1,1,2,2-tetrafluoroethyl ether ($CF_3CH_2OCF_2CF_2H$), 1,1,2,3,3,3-hexafluoropropyl ~~1,1,2,3,3,3-pentafluoropropyl~~ methyl ether ($CF_3CFHCF_2OCH_3$), nonafluorobutyl methyl ether ($C_4F_9OCH_3$), 1-trifluoromethyl-1,2,2,2-tetrafluoroethyl methyl ether ($(CF_3)_2CFOCH_3$), perfluoropropyl methyl ether ($CF_3CF_2CF_2OCH_3$), 2,2,3,3,3-pentafluoropropyl difluoromethyl ether ($CF_3CF_2CH_2OCHF_2$), 1,2,3,3,4,4-hexafluorocyclobutane ($c-C_4F_6H_2$), 1-chloro-1,1,2,2,3,3,4,4-octafluorobutane ($CF_2ClCF_2CF_2CF_2H$, boiling point: 50°C), 1,2-dichlorohexafluorocyclobutane ($-CFCICFCICF_2CF_2-$, boiling point: 60°C), and 1,1,1,3,3,3-hexafluoropropan-2-ol ($CF_3CH(OH)CF_3$, boiling point: 59°C);

wherein the organic blowing agent further comprises at least one member selected from the group consisting of ethylene glycol compounds and amide compounds; and

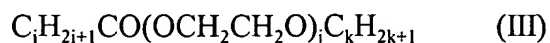
wherein the ethylene glycol compound is at least one member selected from the group consisting of those of the following Formulae (I), (II) and (III):



wherein a represents 1, 2, 3 or 4; b represents 1, 2 or 3; and c represents 1, 2, 3 or 4;



wherein d represents 0, 1, 2, 3 or 4; e represents 1, 2 or 3; and f represents 0, 1, 2, 3 or 4; and



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wherein i represents 0, 1, 2, 3 or 4; j represents 1, 2 or 3; and k represents 1, 2, 3 or 4,
and the amide compound is at least one member selected from the group consisting of those of the
following Formulae (A) and (B):



wherein R¹ is a hydrogen atom, a lower alkyl group or a phenyl group; and R² and R³
are the same or different, and independently represent a hydrogen atom or a lower alkyl group; with
the proviso that R¹ and R² may form a heterocyclic ring in conjunction with the carbon atom of the
carbonyl group to which R¹ is bound and the nitrogen atom to which R² is bound; and



wherein R⁴, R⁵, R⁶ and R⁷ are the same or different, and represent a hydrogen atom or
a lower alkyl group, with the proviso that R⁴ and R⁶ may form a heterocyclic ring in conjunction with
the nitrogen atom to which R⁶ is bound, the nitrogen atom to which R⁴ is bound and the carbon atom
of the carbonyl group.

Claims 18-19: (Canceled).

Claim 20 (Previously Presented): The premix according to Claim 17, wherein the
halogen-containing compound is 1,1,1,2,3,3,3-heptafluoropropane (HFC227ea: CF₃CFHCF₃).

Claim 21: (Canceled).